Dr. Dominik M. Krupke

Curriculum Vitae

▬▬▬ Experience

Mar. 2022 - present	**Postdoc-Researcher and Teacher**, *TU Braunschweig, IBR, Algorithms Group (Prof. Fekete)*, Braunschweig, Germany.
Nov. 2022 - Jan. 2023	**Guest Researcher (3 Months)**, *Tel Aviv University, CGL (Prof. Halperin)*, Tel Aviv, Israel.
Nov. 2016 - Mar. 2022	**Researcher and Teaching Assistant**, *TU Braunschweig, IBR, Algorithms Group (Prof. Fekete)*, Braunschweig, Germany.

▬▬▬ Education

2016-2022	**Dr. rer. nat.**, *TU Braunschweig*, Braunschweig, Germany, *Grade "Summa Cum Laude"*. Computer Science - Algorithms
2014-2016	**Master of Science**, *TU Braunschweig*, Braunschweig, Germany, *Grade 1.0 "With Honors"*. Computer Science
2011-2014	**Bachelor of Science**, *TU Braunschweig*, Braunschweig, Germany, *Grade 1.2 "With Honors"*. Computer Science

▬▬▬ Dissertation

Title	*Algorithm Engineering for Hard Problems in Computational Geometry*
Reviewer	Prof. Sándor P. Fekete, Prof. William J. Cook, Prof. Jospeh S.B. Mitchell
Download	`https://krupke.cc/assets/pdf/dissertation_veroeffentlichung.pdf`
Description	Many practically relevant problems in Computational Geometry are provably hard to solve. In this thesis, we consider a series of these problems and tackle them with techniques from algorithm engineering, e.g., mixed integer programming or deep reinforcement learning. Additionally, we provide a number of results on complexity and algorithms for these problems.

Skills

Technical Skills

Combinatorial Optimization: Proficient in solving NP-hard problems to optimality using techniques like Mixed Integer Programming, Constraint Programming, custom branch-and-bound algorithms, SAT-solvers, and Second Order Cone Programming.

Approximation and Meta-heuristics: Skilled in finding near-optimal solutions using meta-heuristic techniques and large neighborhood search methods.

Algorithmic Foundations: Strong background in theoretical computer science, with a comprehensive understanding of algorithmic concepts and their practical applications.

Programming and Performance Tuning: Adept in writing maintainable Python and C++ code for complex algorithms, with expertise in performance tuning and modularization.

Data Analysis and Visualization: Capable of managing, evaluating, and quality-checking complex data, as well as visualizing data sets for insights and decision-making.

Machine Learning: Familiar with machine learning techniques and have applied them successfully in research projects. Eager to explore their potential to augment classical algorithms, although this is neither a primary focus nor an area of expertise.

Research Skills

Theory-Practice Bridge: Skillful in bridging the gap between theoretical computer science and practical implementation.

Interdisciplinary Collaboration: Extensive experience in cross-disciplinary projects, including work in robotics, bioinformatics, the automotive industry, and satellite management.

Creativity and Curiosity: Demonstrated curiosity and creativity in learning and combining new techniques.

Soft Skills

Teaching and Presentation: Proficient in teaching and presenting complex topics.

Project Management: Experienced in managing multiple projects and student teams concurrently.

Public Engagement: Successfully managed multiple competitions, showcasing organizational skills and the ability to engage with broader audiences.

Awards and Achievements

2014   Disproved a conjecture of Erik D. Demaine, see `https://erikdemaine.org/papers/BoundaryDetection_IROS2009/`.

2014   Prize of the German Informatics Society (GI) for the outstanding undergraduate student in Computer Science.

2016   Solved Problem 53 of The Open Problems Project (`https://topp.openproblem.net/p53`)

2017	Prize of the German Informatics Society (GI) for the outstanding masters student in Computer Science.
2019	Best Paper Award at International Conference on Algorithms and Complexity (CIAC 2019)
2023	Best Paper Award at SIAM Symposium on Algorithm Engineering and Experiments (ALENEX 2023)

Projects

ProvideQ/ QuBRA	Researcher on estimating the impact of quantum computing on combinatorial optimization problems. My primary task in these projects is to provide the baseline of what classical computers are already capable of.
ASIMOV	Partner for the algorithmic side in a project on satellite automation for the European Space Agency. `https://www.esa.int/Enabling_Support/Preparing_for_the_Future/Discovery_and_Preparation/Going_going_gone!_Why_we_could_soon_be_using_auctions_to_download_satellite_data`
CG:SHOP	Technical lead and co-organizer for a yearly challenge on solving hard optimization problems in computational geometry. Official part of the flagship conference SoCG. `https://cgshop.ibr.cs.tu-bs.de/`
VW	Researcher and developer for some smaller projects for Volkswagen.
ROBUST	Project on disease module mining using Steiner trees (bioinformatics).
slurminade	A Python-package that allows to distribute Python function calls on a Slurm cluster by a simple decorator. `https://github.com/d-krupke/slurminade`
AlgBench	A Python-packages for data collection and management of algorithmic experiments. `https://github.com/d-krupke/AlgBench`
CP-SAT Primer	A primer on Google's OR-Tools CP-SAT solver I started for my students because the official documentation did not reveal enough details. It is still a work in progress, but already has over 100 stars and is one of the first results when googling for *CP-SAT*. `https://github.com/d-krupke/cpsat-primer`
CheckMyTex	A small side project that originated from the need to find and fix errors and inconsistencies in my dissertation.
. . .	*See publications and dissertation for more projects and research.*

Programming Skills

Python	Advanced knowledge, as indicated by my Python projects. Python is my go-to language for algorithmic prototyping, as it allows me to write complex code that is still readable with a few lines (especially mathematical programming). Aside from the great ecosystem (Pandas, NumPy, Matplotlib,. . .), I also like that Python makes it easy to include other languages, allowing me to implement the performance critical parts in C++. With my tool *skbuild_conan*, I also made it comfortable to use C++ libraries in Python.

C++	I know how to write fast and efficient C++-code, and have experience with many compiler and optimization details. However, I only use C++ when I need its efficiency, as I find it too verbose and error-prone for most tasks.
Other	Over the years, I have learned and used various other languages (Java, Ruby, C, Assembly, Javascript,...) and I am generally open to learn new languages. For example, I consider Rust and Julia as promising languages for the future, but currently they miss libraries that are important for my work.
...	**Also check `https://github.com/d-krupke`.**

Teaching

Lecturer	Designing and teaching a new course from scratch on algorithm engineering.
Assistant	Providing tutorials and designing exercises for courses on mathematical optimization and approximation algorithms.
Labs	Supervising multiple software development practicals with groups of up to 12 students, in which a medium-sized software product has to be developed during a semester. My students have won the best project award two out of five years.
Theses	Supervising many bachelor and master theses on various topics in algorithmic.

Other

Program Comittee	I have been in the program comittee of the SIAM Symposium on Algorithm Engineering and Experiments (ALENEX23).

Languages

German	**Native speaker**	
English	**Advanced**	*Conversational and written fluency*

Interests

Fitness	Pushing my body to the limits through weight lifting and Krav Maga helps me keep my mind and body in balance.

Publications (please note: Authors are ordered **alphabetically**)

2024	Sándor Fekete, Phillip Keldenich, Dominik Krupke, and Eike Niehs. "Edge Sparsification for Geometric Tour Problems". In: *Computing in Geometry and Topology* 3.1, 1:1–1:23. DOI: 10.57717/cgt.v3i1.20. URL: `https://www.cgt-journal.org/index.php/cgt/article/view/20`.
	Dominik Krupke. "Near-Optimal Coverage Path Planning with Turn Costs". In: *2024 Proceedings of the Symposium on Algorithm Engineering and Experiments (ALENEX)*. SIAM, pp. 118–132.
2023	Sándor P Fekete, Phillip Keldenich, Dominik Krupke, and Stefan Schirra. "Minimum partition into plane subgraphs: The CG: SHOP Challenge 2022". In: *ACM Journal of Experimental Algorithmics* 28, pp. 1–13.

Sándor P Fekete, Dominik Krupke, Michael Perk, Christian Rieck, and Christian Scheffer. "A Closer Cut: Computing Near-Optimal Lawn Mowing Tours". In: *2023 Proceedings of the Symposium on Algorithm Engineering and Experiments (ALENEX)*. SIAM, pp. 1–14.

Sándor P Fekete, Dominik Krupke, Michael Perk, Christian Rieck, and Christian Scheffer. "The Lawn Mowing Problem: From Algebra to Algorithms". In: *31st Annual European Symposium on Algorithms (ESA 2023)*. Schloss Dagstuhl-Leibniz-Zentrum für Informatik.

2022   Judith Bernett, Dominik Krupke, Sepideh Sadegh, Jan Baumbach, Sándor P. Fekete, Tim Kacprowski, Markus List, and David B. Blumenthal. "Robust disease module mining via enumeration of diverse prize-collecting Steiner trees". In: *Bioinformatics*. DOI: 10.1093/bioinformatics/btab876. URL: https://doi.org/10.1093/bioinformatics/btab876.

Kevin Buchin, Alexander Hill, Sándor Fekete, Linda Kleist, Irina Kostitsyna, Dominik Krupke, Roel Lambers, and Martijn Struijs. "Minimum Scan Cover and Variants: Theory and Experiments". In: *ACM Journal of Experimental Algorithmics* 27, pp. 1–28.

Erik D. Demaine, Sándor P. Fekete, Phillip Keldenich, Dominik Krupke, and Joseph S. B. Mitchell. "Area-Optimal Simple Polygonalizations: The CG Challenge 2019". In: *ACM J. Exp. Algorithmics* 27, 2.4:1–2.4:12. DOI: 10.1145/3504000. URL: https://doi.org/10.1145/3504000.

Sándor P. Fekete, Phillip Keldenich, Dominik Krupke, and Joseph S. B. Mitchell. "Computing Coordinated Motion Plans for Robot Swarms: The CG: SHOP Challenge 2021". In: *ACM J. Exp. Algorithmics* 27, 3.1:1–3.1:12. DOI: 10.1145/3532773. URL: https://doi.org/10.1145/3532773.

2021   Kevin Buchin, Sándor P. Fekete, Alexander Hill, Linda Kleist, Irina Kostitsyna, Dominik Krupke, Roel Lambers, and Martijn Struijs. "Minimum Scan Cover and Variants - Theory and Experiments". In: *19th International Symposium on Experimental Algorithms, SEA 2021, June 7-9, 2021, Nice, France*. Vol. 190. LIPIcs. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, 4:1–4:16. DOI: 10.4230/LIPIcs.SEA.2021.4. URL: https://doi.org/10.4230/LIPIcs.SEA.2021.4.

Sándor P. Fekete, Linda Kleist, and Dominik Krupke. "Minimum Scan Cover with Angular Transition Costs". In: *SIAM J. Discret. Math.* 35.2, pp. 1337–1355. DOI: 10.1137/20M1368161. URL: https://doi.org/10.1137/20M1368161.

2020   Aaron T. Becker, Sándor P. Fekete, Li Huang, Phillip Keldenich, Linda Kleist, Dominik Krupke, Christian Rieck, and Arne Schmidt. "Targeted Drug Delivery: Algorithmic Methods for Collecting a Swarm of Particles with Uniform, External Forces". In: *2020 IEEE International Conference on Robotics and Automation, ICRA 2020, Paris, France, May 31 - August 31, 2020*. IEEE, pp. 2508–2514. DOI: 10.1109/ICRA40945.2020.9196551. URL: https://doi.org/10.1109/ICRA40945.2020.9196551.

Aaron T. Becker, Sándor P. Fekete, Phillip Keldenich, Dominik Krupke, Christian Rieck, Christian Scheffer, and Arne Schmidt. "Tilt Assembly: Algorithms for Microfactories That Build Objects with Uniform External Forces". In: *Algorithmica* 82.2, pp. 165–187. DOI: 10.1007/s00453-018-0483-9. URL: `https://doi.org/10.1007/s00453-018-0483-9`.

Mohamed Ben Larbi, Kattia Pozo, Mirue Choi, Tom Haylok, Benjamin Grzesik, Andreas Haas, Dominik Krupke, Harald Konstanski, Volker Schaus, Sándor Fekete, Christian Schurig, and Enrico Stoll. "Towards the Automated Operations of Large Distributed Satellite Systems. Part 2: Classifications and Tools". In: *Advances in Space Research* 67. DOI: 10.1016/j.asr.2020.08.018.

Mohamed Ben Larbi, Kattia Pozo, Tom Haylok, Mirue Choi, Benjamin Grzesik, Andreas Haas, Dominik Krupke, Harald Konstanski, Volker Schaus, Sándor Fekete, Christian Schurig, and Enrico Stoll. "Towards the Automated Operations of Large Distributed Satellite Systems. Part 1: Review and Paradigm Shifts". In: *Advances in Space Research* 67. DOI: 10.1016/j.asr.2020.08.009.

Sándor P. Fekete, Alexander Hill, Dominik Krupke, Tyler Mayer, Joseph S. B. Mitchell, Ojas Parekh, and Cynthia A. Phillips. "Probing a Set of Trajectories to Maximize Captured Information". In: *18th International Symposium on Experimental Algorithms, SEA 2020, June 16-18, 2020, Catania, Italy*. Vol. 160. LIPIcs. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, 5:1–5:14. DOI: 10.4230/LIPIcs.SEA.2020.5. URL: `https://doi.org/10.4230/LIPIcs.SEA.2020.5`.

Sándor P. Fekete, Linda Kleist, and Dominik Krupke. "Minimum Scan Cover with Angular Transition Costs". In: *36th International Symposium on Computational Geometry, SoCG 2020, June 23-26, 2020, Zürich, Switzerland*. Vol. 164. LIPIcs. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, 43:1–43:18. DOI: 10.4230/LIPIcs.SoCG.2020.43. URL: `https://doi.org/10.4230/LIPIcs.SoCG.2020.43`.

2019   Sándor P. Fekete and Dominik Krupke. "Covering Tours and Cycle Covers with Turn Costs: Hardness and Approximation". In: *Algorithms and Complexity - 11th International Conference, CIAC 2019, Rome, Italy, May 27-29, 2019, Proceedings*. Vol. 11485. Lecture Notes in Computer Science. Springer, pp. 224–236. DOI: 10.1007/978-3-030-17402-6_19. URL: `https://doi.org/10.1007/978-3-030-17402-6_19`.

Sándor P. Fekete and Dominik Krupke. "Practical Methods for Computing Large Covering Tours and Cycle Covers with Turn Cost". In: *Proceedings of the Twenty-First Workshop on Algorithm Engineering and Experiments, ALENEX 2019, San Diego, CA, USA, January 7-8, 2019*. SIAM, pp. 186–198. DOI: 10.1137/1.9781611975499.15. URL: `https://doi.org/10.1137/1.9781611975499.15`.

Dominik Krupke, Volker Schaus, Andreas Haas, Michael Perk, Jonas Dippel, Benjamin Grzesik, Mohamed Khalil Ben Larbi, Enrico Stoll, Tom Haylock, Harald Konstanski, Kattia Flores Pozo, Mirue Choi, Christian Schurig, and Sándor P. Fekete. "Automated Data Retrieval from Large-Scale Distributed Satellite Systems". In: *15th IEEE International Conference on Automation Science and Engineering, CASE 2019, Vancouver, BC, Canada, August 22-26, 2019*. IEEE, pp. 1789–1795. DOI: `10.1109/COASE.2019.8843045`. URL: `https://doi.org/10.1109/COASE.2019.8843045`.

Volker Schaus, Dominik Krupke, Mohamed Ben Larbi, Andreas Haas, Benjamin Grzesik, Jonas Radtke, Sándor Fekete, and Enrico Stoll. "Automated Constellation Management With Self-Regulating Data-Economic Actors". In: *70th International Astronautical Congress (IAC)*.

2018   Phillip Keldenich, Sheryl Manzoor, Li Huang, Dominik Krupke, Arne Schmidt, Sándor P. Fekete, and Aaron T. Becker. "On Designing 2D Discrete Workspaces to Sort or Classify Polynminoes". In: *2018 IEEE/RSJ International Conference on Intelligent Robots and Systems, IROS 2018, Madrid, Spain, October 1-5, 2018*. IEEE, pp. 1–9. DOI: `10.1109/IROS.2018.8594150`. URL: `https://doi.org/10.1109/IROS.2018.8594150`.

An Nguyen, Dominik Krupke, Mary Burbage, Shriya Bhatnagar, Sándor P. Fekete, and Aaron T. Becker. "Using a UAV for Destructive Surveys of Mosquito Population". In: *2018 IEEE International Conference on Robotics and Automation, ICRA 2018, Brisbane, Australia, May 21-25, 2018*. IEEE, pp. 7812–7819. DOI: `10.1109/ICRA.2018.8463184`. URL: `https://doi.org/10.1109/ICRA.2018.8463184`.

2017   Aaron T. Becker, Mustapha Debboun, Sándor P. Fekete, Dominik Krupke, and An Nguyen. "Zapping Zika with a Mosquito-Managing Drone: Computing Optimal Flight Patterns with Minimum Turn Cost (Multimedia Contribution)". In: *33rd International Symposium on Computational Geometry, SoCG 2017, July 4-7, 2017, Brisbane, Australia*. Vol. 77. LIPIcs. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, 62:1–62:5. DOI: `10.4230/LIPIcs.SoCG.2017.62`. URL: `https://doi.org/10.4230/LIPIcs.SoCG.2017.62`.

Aaron T. Becker, Sándor P. Fekete, Phillip Keldenich, Dominik Krupke, Christian Rieck, Christian Scheffer, and Arne Schmidt. "Tilt Assembly: Algorithms for Micro-Factories that Build Objects with Uniform External Forces". In: *28th International Symposium on Algorithms and Computation, ISAAC 2017, December 9-12, 2017, Phuket, Thailand*. Vol. 92. LIPIcs. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, 11:1–11:13. DOI: `10.4230/LIPIcs.ISAAC.2017.11`. URL: `https://doi.org/10.4230/LIPIcs.ISAAC.2017.11`.

Sándor P. Fekete, Andreas Haas, Michael Hemmer, Michael Hoffmann, Irina Kostitsyna, Dominik Krupke, Florian Maurer, Joseph S. B. Mitchell, Arne Schmidt, Christiane Schmidt, and Julian Troegel. "Computing nonsimple polygons of minimum perimeter". In: *J. Comput. Geom.* 8.1, pp. 340–365. DOI: `10.20382/jocg.v8i1a13`. URL: `https://doi.org/10.20382/jocg.v8i1a13`.

Arun Mahadev, Dominik Krupke, Sándor P. Fekete, and Aaron T. Becker. "Mapping and coverage with a particle swarm controlled by uniform inputs". In: *2017 IEEE/RSJ International Conference on Intelligent Robots and Systems, IROS 2017, Vancouver, BC, Canada, September 24-28, 2017*. IEEE, pp. 1097–1104. DOI: 10.1109/IROS.2017.8202280. URL: `https://doi.org/10.1109/IROS.2017.8202280`.

2016   Sándor P. Fekete, Andreas Haas, Michael Hemmer, Michael Hoffmann, Irina Kostitsyna, Dominik Krupke, Florian Maurer, Joseph S. B. Mitchell, Arne Schmidt, Christiane Schmidt, and Julian Troegel. "Computing Nonsimple Polygons of Minimum Perimeter". In: *Experimental Algorithms - 15th International Symposium, SEA 2016, St. Petersburg, Russia, June 5-8, 2016, Proceedings*. Vol. 9685. Lecture Notes in Computer Science. Springer, pp. 134–149. DOI: 10.1007/978-3-319-38851-9_10. URL: `https://doi.org/10.1007/978-3-319-38851-9_10`.

Arun V. Mahadev, Dominik Krupke, Jan-Marc Reinhardt, Sándor P. Fekete, and Aaron T. Becker. "Collecting a swarm in a grid environment using shared, global inputs". In: *IEEE International Conference on Automation Science and Engineering, CASE 2016, Fort Worth, TX, USA, August 21-25, 2016*. IEEE, pp. 1231–1236. DOI: 10.1109/COASE.2016.7743547. URL: `https://doi.org/10.1109/COASE.2016.7743547`.

2015   Dominik Krupke, Maximilian Ernestus, Michael Hemmer, and Sándor P. Fekete. "Distributed cohesive control for robot swarms: Maintaining good connectivity in the presence of exterior forces". In: *2015 IEEE/RSJ International Conference on Intelligent Robots and Systems, IROS 2015, Hamburg, Germany, September 28 - October 2, 2015*. IEEE, pp. 413–420. DOI: 10.1109/IROS.2015.7353406. URL: `https://doi.org/10.1109/IROS.2015.7353406`.

Dominik Krupke, Michael Hemmer, James McLurkin, Yu Zhou, and Sándor P. Fekete. "A parallel distributed strategy for arraying a scattered robot swarm". In: *2015 IEEE/RSJ International Conference on Intelligent Robots and Systems, IROS 2015, Hamburg, Germany, September 28 - October 2, 2015*. IEEE, pp. 2795–2802. DOI: 10.1109/IROS.2015.7353761. URL: `https://doi.org/10.1109/IROS.2015.7353761`.

2014   Björn Bankowski, Thiemo Clausen, Dirk Ehmen, Maximilian Ernestus, Henning Hasemann, Tobias Jura, Alexander Kröller, Dominik Krupke, and Marco Nikander. "Panic Room: Experiencing Overload and Having Fun in the Process". In: *Distributed, Ambient, and Pervasive Interactions - Second International Conference, DAPI 2014, Held as Part of HCI Interational 2014, Heraklion, Crete, Greece, June 22-27, 2014. Proceedings*. Vol. 8530. Lecture Notes in Computer Science. Springer, pp. 241–252. DOI: 10.1007/978-3-319-07788-8_23. URL: `https://doi.org/10.1007/978-3-319-07788-8_23`.

See also `https://scholar.google.de/citations?user=rZ4784MAAAAJ&hl=en`